



DOCUMENT

Copernicus Space Component

ESA-USGS Technical Operating Arrangements

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1 INTRODUCTION

1.1 Background

Copernicus is a European programme, providing Earth Observation information for environmental monitoring and civil security. The dedicated Sentinels missions are being developed to meet the operational needs of the programme.

According to Article 9 of the Regulation establishing the Copernicus programme, the European Commission manages, on behalf of the European Union (EU) and in its field of competence, relationships with third countries and international organisations.

In line with this Regulation, the European Commission has concluded Agreements with the European Space Agency (ESA) and the European Organization for the Exploitation of Meteorological Satellites (EUMETSAT) on the implementation of the space component of Copernicus.

These Agreements foresee that ESA and EUMETSAT shall provide support to the EU for the matters concerning the international technical cooperation of the Copernicus Programme. In particular, ESA and EUMETSAT shall assess the impact of international technical cooperation requests and shall implement and be responsible for technical actions with international partners subject to the prior approval of the European Commission and prerequisite funding provided by the European Union.

On this basis, the European Commission requests ESA and EUMETSAT to establish relevant technical operating arrangements with international partners, primarily focusing on the Sentinels operated by ESA and EUMETSAT and addressing issues such as liability and technical data interface specifications.

ESA and EUMETSAT will be responsible for the implementation of the technical operating arrangements, in coordination and subject to the prior agreement by the European Commission.

The implementation of the technical operating arrangements is intended to be facilitated by a joint 'Copernicus Cooperation group', involving the European Commission, ESA, EUMETSAT and the international partners, whose members meet whenever necessary, to oversee and stimulate cooperative activities (e.g. exchange of best practices, comparison of products, exchange of personnel).



1.2 Purpose and Objectives

The European Union, represented by the European Commission, and the United States of America, represented by the US State Department have signed a Cooperation Arrangement to ensure the access to Sentinel data for the United States of America. Specifically, the European Union and United States recognize full and free access to each other's environmental satellite data is of mutual benefit and should follow the GEOSS Data Sharing Principles. U.S. agencies, including the U.S. National Oceanic and Atmospheric Administration (NOAA), the U.S. National Aeronautics and Space Administration (NASA), and the U.S. Geological Survey (USGS) are expected to continue to provide a wide range of observations and the European Commission intends to provide high bandwidth connections to U.S. agencies to access Sentinel data. In addition to data sharing, collaborations are being encouraged in areas of calibration/validation, development of societal applications and coordination on spectrum issues.

Based on this Cooperation Arrangement, ESA and the United States Geological Survey (hereinafter referred to as "USGS") intend to coordinate the technical implementation covering the Sentinel data access to USGS by developing this technical operating arrangements document signed by USGS and ESA.

Based on this Cooperation Agreement, ESA and USGS cooperate on a voluntary basis for enabling Sentinel data access to the USGS, without any exchange of funds. In the event that either ESA or USGS is unable to continue one or several of the activities described in this technical operating arrangements document, each may have the option of terminating the participation in the activity, after consultation with the other and after giving reasonable advance notice.

The purpose of these technical operating arrangements is to define ESA and USGS respective roles and responsibilities as well as the terms and conditions under which they intend to cooperate to implement the exchange of satellite data foreseen in the Cooperation Arrangement between the European Commission and the International partner on Cooperation on Earth Observation data related to the Copernicus programme.

In this arrangement both sides recognise that the European Union and United States of America are pursuing Earth Observation activities in a number of areas of common interest and that sharing each other's satellite data on the basis of reciprocity should provide mutual benefits. Both sides are committed to the principle of full, free and open access to European Sentinel and USGS Earth Observation satellite data and information, subject to applicable security restrictions.



1.3 Scope

This non-binding document describes the technical operating arrangements (e.g. cooperative initiatives description, operational interfaces, ESA required support) between both Agencies.

In case other entities (e.g. Universities, Institutes) are involved in the arrangement on the USGS's side, the USGS acts as an interface and contact point between ESA and the other entity.

ESA and USGS maintain long-standing cooperation in the fields of Earth Observation (e.g. internet and other access to relevant USGS satellite data, i.e. through specific data acquisition services, specific data products, mirror sites, etc.). These and potential future activities are not subject to this technical operating arrangements document, but may be defined in other documents.

1.4 References

An overview of the overall Copernicus dedicated Sentinel missions is available in the Sentinel Online portal at sentinels.copernicus.eu. In particular the portal contains up to date information on:

- Mission description, including space and ground segment aspects, and operational news
- Products definition, including contents and format specifications
- Detailed mission user handbook
- Link to data access hubs, including registration, user manuals, operational news

The following documents are referenced in this technical operating arrangement document and provide further detailed information.

[RD-1] CSC Operations Concept document, GMES-GSEG-EOPG-PD-12-0056, Issue 1.1, <https://sentinel.esa.int/documents/247904/690755/Operations-Concept-Data-Access.pdf>

[RD-2] “Legal notice on the use of Copernicus Sentinel Data and Service Information”, https://sentinel.esa.int/documents/247904/690755/Sentinel_Data_Terms_and_Conditions



2 EUROPEAN ACCESS TO USGS MISSION AND CALIBRATION DATA

In adherence to its free-and-open data policy, USGS intends to continue to provide Earth observation data products to European users. This includes, but is not limited to, data made available on the USGS Earth Explorer customer-interface site

([http:// earthexplorer.usgs.gov/](http://earthexplorer.usgs.gov/)), such as the Landsat data sets dating back to 1972.

Specific USGS activities to further collaboration with ESA are outlined in Sections 5.1 and 6.2 to:

- develop shared algorithms and processing methodologies to enhance the interoperability and synergistic use of Landsat and Sentinel-2 data streams including Level-2 (surface reflectance) product development activities
- perform studies on Sentinel-2 radiometric and geometric characterization

USGS intends to share data access information with ESA. Links may allow ESA to retrieve certain datasets or may be posted on ESA and EU Copernicus data access portals to inform European users.

3 ARRANGEMENT TECHNICAL INTERFACES

In the frame of Copernicus, technical operating arrangements aim, among others, at providing:

- a supplementary access to Sentinel Missions data, e.g. through specific data acquisition services (data hub to data hub), specific data products, mirror sites, etc., thus further valorising the Sentinel missions exploitation.
- access to relevant USGS Mission data, i.e. through specific data acquisition services (data hub to data hub), specific data products, mirror sites, etc., thus further valorising the relevant missions exploitation.

3.1 Technical Operating Arrangements Types

The technical operating arrangements provide a frame for specialised solutions in five main areas:

1. Data acquisition and Quasi Real Time production (International Local Stations – currently not foreseen)
2. Complementary collaborative data products and algorithms definition



3. Core data product dissemination and access (e.g. international mirror sites)
4. Development of innovative tools and applications
5. Complementary external validation support activities

The following sections define the technical operating arrangements for the specific area of cooperation.

In the frame of these technical operating arrangements:

- additional areas of technical cooperation may be included in the future if relevant and with prior endorsement by the European Commission.
- regular technical meetings are intended to be held between the USGS and ESA, e.g. within the Copernicus Cooperation Group, the latter co-led by the European Commission for European partners and an agency to be determined for the U.S. partners. It is intended that the European Commission be invited as an observer to all such meetings and that all meeting documentation be forwarded to the European Commission for information.

4 INTERNATIONAL ARCHIVING AND DISSEMINATION CENTRES, MIRROR SITE

4.1 Involved Entities

At this time, the USGS intends to be involved directly with ESA's International Data Hub (IntDH) for retrieving, archiving, and disseminating Sentinel-2 products.

4.2 USGS Activity

The USGS intends to retrieve Sentinel-2 Multispectral Imager (MSI) Level-1c data products from the Sentinel International Data Hub (IntDH) to the Earth Resources Observation and Science (EROS) Center using standard network transfer protocols via Internet, or, if available Internet2 from the U.S. and associated network (e.g. GÉANT) in Europe. Data are expected to be received on the EROS ingest server and stored directly onto an archive file system. The ingest servers monitor for new data, create full resolution and reduced resolution browse images from the Sentinel-2 Level-1c data, move the data from the ingest directory to the archive directory, and insert metadata records into the inventory database. Data archive copies are



expected to be created and standard operational procedures should be followed using the rule-based policy of the archive directory to create two tape copies, both near-line and off-line. This is intended to be the full scope of USGS data management activities. The USGS does not intend to serve as a “hot failover site” in the event of a disruption of service to the Copernicus Space Component Core Ground System services.

The Sentinel-2 Level-1c data products should be made available to the user community without cost or any restrictions on use and redistribution through the EarthExplorer (EE) and GloVis ordering interfaces. The product metadata files should be modified to include acknowledgement in accordance with [RD-2]. Data distribution and user metrics are intended to be captured and reported back to ESA for the Copernicus program.

4.3 ESA Support

4.3.1 Access to the Sentinel International Data Hub

ESA grants the USGS access to the International Data Hub (IntDH), a rolling archive, providing bulk dissemination capabilities for Sentinel data products. The IntDH will continuously store Sentinel data acquired during the previous month(s) at the processing levels agreed to as part of the Sentinel core data product list and the associated timeliness as defined in the CSC Operations Concept Document, [RD-1]. It enables searching, browsing, previewing and downloading the Sentinel data. The time interval covered by the IntDH rolling archive will be scalable and include at least the previous 30 days of data.

Access to the Sentinel archived data is provided via a separated data access infrastructure not subject of this technical operating arrangements document. If required in the future, a specific campaign could be put in place as a separate activity to be coordinated with other international partners to transfer reprocessed or missing data. Such a campaign, including selected archived data publishing in the IntDH, may also apply in the future to make re-processed Sentinel data available.

Access to the IntDH is allowed via a web authentication module. ESA will provide the USGS with a username and password to access the IntDH. This username and password may be used only by the USGS (including its representatives, employees and contractors involved in the initiative) for the purpose of the initiative and will not be shared with other natural or legal persons.



The USGS is expected to use the IntDH access only for the purpose of its activity in the initiative described above. Through registration at the IntDH, accessing and/or downloading available content, the USGS should not misuse or interfere with the service of the IntDH portal. In particular, the USGS aims at building up a mirror archive of Sentinel data and hence should avoid downloading identical datasets from the IntDH more than once. Rather, the USGS is expected to store downloaded Sentinel data for re-use and re-dissemination.

All functionalities and contents offered by the IntDH are provided by ESA on a best efforts basis. The transmission of content from the IntDH may be interrupted or delayed by ESA in the event of technical constraints, such as the Internet bandwidth. In such case, the download requested by the USGS should be enabled later taking into account other users' requests.

4.3.2 Data Transfer

ESA will provide appropriate interfaces to access Sentinel data from the USGS using standard network transfer protocols via Internet. The IntHub is today connected to the Public Internet and GÉANT via a commercial provider. Further, ESA intends to establish in the future a direct connection with GÉANT to facilitate the connectivity with Internet2 and U.S. users.

4.4 Time Schedule

Following the October 16, 2015 signature of the U.S. – EC Cooperation Arrangement on the Cooperation on Earth Observation data related to the Copernicus programme, the IntDH is intended to be available by February 1, 2016. Sentinel-2 data will become available in accordance with ESA data provision plan (e.g. after launch, commensurate with the ramp-up plan for data provision, as available at sentinels.copernicus.eu). The USGS intends to retrieve Sentinel-2 data as soon as it becomes available on the public or International Data Hubs within the prescribed residence time of the rolling archive. The USGS goal is to retrieve data within 24 hours of its availability in order to mitigate the need to transfer data exceeding the Level-1C production rate of approximately 1.6 terabytes per day.

4.5 Reporting

The USGS is expected to keep ESA and the European Commission (via ESA) informed about the course and success of the activity. ESA will provide this information to the European Commission as part of their reporting tasks.



The regular reports regarding the Sentinel data mirror site are intended to have at least annual frequency, and are intended to as a minimum contain information regarding:

- Sentinel data use and applications;
- Onward-dissemination of Sentinel data, including user statistics of the national mirror site;
- Any changes to the pre-agreed set up of activities that may have an impact on ESA’s support to the partner’s activities.

More specifically, as concerns Sentinel data Mirror Site usage statistics, the following minimum categories of information are intended to be provided to ESA as part of the annual reports.

User account statistics, including:

- Utilisation domain (i.e. research, commercial, education, other)
- Usage field (i.e. atmosphere, emergency, marine, land, security, climate, other)
- Country of the account user

Note: the above fields should be requested as part of the user account registration

Data dissemination statistics, including:

- Data delivered by affiliation and usage field
- Data volume by affiliation and usage field
- Total number of distinct users
- Total volume of data distributed
- Total volume of data distributed by product
- Statistics on the core product delivered as defined in [RD-1], refer also to <https://sentinels.copernicus.eu/documents/247904/685154/Sentinel+Products+List-Issue1-Rev1.pdf>

4.6 Sentinel Data Governance

Sentinel data made available via the IntDH are governed by the “Legal notice on the use of Copernicus Sentinel Data and Service Information”, [RD-2]. The USGS accepts these conditions implicitly by using or distributing the Sentinel data.



In the event that in the future specific Sentinel data are assessed by the EU to be “sensitive” the access to such Sentinel data through the IntDH and its use and distribution may be subject to different licensing conditions. This also applies for Sentinel data already received by the USGS, through the IntDH, in the event Sentinel data are assessed to be “sensitive” after the time of data download.

5 ADDITIONAL SENTINEL DATA SERVICES AND PRODUCTS

5.1 USGS Activity

In addition, the USGS in collaboration with NASA and with participation from European scientists and engineers may develop algorithms and processing methodologies in order to enhance the interoperability and synergistic use of Landsat and Sentinel-2 data streams. These development activities would focus on Level-2 products, specifically the retrieval of surface reflectance data that include radiometric cross-calibration, spectral band pass adjustments, bidirectional reflectance distribution function (BRDF) normalization, common gridding and cartographic projections, and compatible metadata.

5.2 ESA Support

5.2.1 Sentinel observation planning

ESA intends to include Sentinel data requirements indicated by the initiative into the Sentinel acquisition planning. The acquisition planning is implemented by ESA according to the Sentinels High level Operations Plan, following the given priorities. Data Requirements for future acquisitions may be communicated to ESA by the USGS at any time. Please note, that Sentinel missions follow a long term planning procedure, so that changes to the acquisition plan can be implemented only approximately every 6 months.

5.2.2 Product quality support

On a case-by-case basis, ESA is available to answer queries and to provide expertise on data processing and data quality.



5.2.3 Advertising and networking support

ESA intends to publish information about the initiative online together with advertising other initiatives utilising Sentinel data. This is to support the networking amongst Sentinel data users and to promote the initiative across partners.

5.3 Reporting

The USGS is expected to keep ESA informed about the course and success of the initiative. ESA will provide this information to the European Commission as part of their reporting tasks.

In particular, reports should provide information on:

- Type of value added products generated
- Number of value added products generated
- Number of value added products distributed

6 INTERNATIONAL COMPLEMENTARY EXTERNAL VALIDATION SUPPORT

The USGS and NASA are expected to collaborate in partnership with ESA in acquiring data over selected calibration and principal investigator (PI) sites during the commissioning and ramp-up phases to perform independent calibration validation and product characterization studies, the results from which are expected to be openly shared with ESA and its Copernicus partners.

6.1 Involved Entities

At this time, the USGS intends to be the only party involved directly with ESA for complementary validation support.

6.2 USGS Activity

The USGS intends to perform studies on the radiometric and geometric characterization of the Sentinel-2 MSI Level-1c data using data acquired over a global network of vicarious calibration sites used by the USGS for its Landsat missions as well as by the Committee on Earth Observing Satellites (CEOS) Working Group on Calibration Validation (WGCV). Data collected of these sites should enable independent assessment of MSI performance parameters such as absolute radiometric uncertainty, spectral uniformity, signal to noise ratio, geodetic and



geometric accuracy, etc. In addition, data collected over other sites are expected to be evaluated for the quality of geophysical and biophysical parameters (e.g. surface reflectance, land cover) derived from the Level-1c products.

6.3 ESA Support

6.3.1 *ESA technical support to complementary validation activity*

ESA will provide sample data sets of the Sentinel-2 core products (e.g. L1, L2) as they become available to support joint validation and calibration activities. Level 2 is currently generated on the users' side by using a processor running on ESA's Sentinel-2 Toolbox. The possibility of making a standard core product systematically available from the Sentinels core ground segment is currently being assessed as part of the CSC evolution activities.

6.4 Time Schedule

The USGS plans to start retrieving data from the IntDH as soon as it is available (section 4.4) and when Sentinel 2 data become publicly accessible. The USGS intends to retrieve data on a daily basis throughout the life of the Sentinel-2 missions unless available funding or programmatic direction determines otherwise.

6.5 Reporting

The USGS is expected to keep ESA informed about the course and success of the activity. ESA will provide this information to the European Commission as part of its reporting tasks.

The regular reports regarding the complementary external validation activity are intended to have at least annual frequency, and are intended to as a minimum contain information regarding:

- Summary of complementary validation results
- Sentinel data use and application;
- Any changes to the pre-agreed set up of activities that may have an impact on ESA's support to the partner's activities.
- Onward-dissemination of Sentinel data (if relevant), including user statistics according to chapter 3.5 above.



Note: reporting on Sentinel data distribution is required only if the initiative comprises systematically onwards distribution of Sentinel data. Distribution on a case-by-case basis is not expected to be subject to reporting.

6.6 Sentinel Data Governance

Sentinel data used by the complementary validation activity are governed by the “Legal notice on the use of Copernicus Sentinel Data and Service Information”, [RD-2].